

Claims

1. A liquid chromatograph pump comprising a cylinder having an inner wall surface and a plunger reciprocating in the cylinder at a driving speed, the plunger being formed on its outer surface with a stepped part along the driving direction of the plunger so as to define a working chamber having a cross-sectional area between the stepped part and the inner wall surface of the cylinder, wherein the flow rate of the liquid chromatograph pump is determined by both cross-sectional area of the working chamber and driving speed of the plunger.

2. A liquid chromatograph pump as set forth in claim 1 comprising a first pump incorporating a first cylinder, and a first plunger reciprocating in the first cylinder, and a second pump incorporating a second cylinder having an inner wall surface, and a second plunger reciprocating in the second cylinder, a suction valve being provided on the upstream side of the first pump, a discharge valve being provided on the downstream side of the first pump, and the stepped part being formed at least on the outer peripheral surface of the second plunger in the second pump, along the driving direction of the second plunger so as to define the working chamber between the stepped part and the inner wall surface of the second cylinder, wherein the second pump is located at the most downstream position among a plurality of pumps provided in the liquid

chromatograph pump.

3. A liquid chromatograph pump as set forth in claim 1, comprising a first pump incorporating a first cylinder, and a first plunger reciprocating in the first cylinder, and a second pump incorporating a second cylinder having an inner wall surface, and a second plunger reciprocating in the second cylinder, a suction valve being provided on the upstream side of the first pump, a discharge valve being provided on the downstream side of the first pump, and the stepped part being formed at least on the outer peripheral surface of the second plunger in the second pump, along the driving direction of the second plunger so as to define the working chamber between the stepped part and the inner wall surface of the second cylinder, wherein the working chamber of the second pump is connected thereto with a discharge passage from the liquid chromatograph pump in which a working chamber defined in the first pump is connected thereto with a suction passage connected to the liquid chromatograph pump, and the first pump and the second pump are connected with each other in series.

4. A liquid chromatograph pump comprising a cylinder having an inner wall surface, and a plunger reciprocating in the cylinder, the plunger being formed on its outer surface with a stepped part along the driving direction of the plunger so as to define a working chamber between the stepped part and the inner

wall surface of the cylinder, wherein an end part of the plunger on the side remote from the drive side, is exposed to a gas atmosphere.

5. A liquid chromatograph pump as set forth in claim 4, comprising a first pump incorporating a first cylinder, and a first plunger reciprocating in the first cylinder, and a second pump incorporating a second cylinder having an inner wall surface, and a second plunger reciprocating in the second cylinder, a suction valve being provided on the upstream side of the first pump, a discharge valve being provided on the downstream side of the first pump, and the stepped part being formed at least on the outer peripheral surface of the second plunger in the second pump, along the driving direction of the second plunger so as to define the working chamber between the stepped part and the inner wall surface of the second cylinder, wherein one end part of the second plunger on the side remote from the drive side is exposed to a gas atmosphere, and the second pump is located at the most downstream position among a plurality of pumps provided in the liquid chromatograph pump.

6. A liquid chromatograph pump as set forth in claim 4, comprising a first pump incorporating a first cylinder, and a first plunger reciprocating in the first cylinder, and a second pump incorporating a second cylinder having an inner wall surface, and a second plunger reciprocating in the second cylinder, a

suction valve being provided on the upstream side of the first pump, a discharge valve being provided on the downstream side of the first pump, and the stepped part being formed at least on the outer peripheral surface of the second plunger in the second pump, along the driving direction of the second plunger so as to define the working chamber between the stepped part and the inner wall surface of the second cylinder, wherein one end part of the second plunger on the side remote from the drive side is exposed to a gas atmosphere, the working chamber in the second pump is connected thereto with a discharge passage from the liquid chromatograph pump, and a working chamber defined in the first pump is connected thereto with a suction passage connected to the liquid chromatograph pump, and the first pump and the second pump is connected to each other in series.

7. A liquid chromatograph pump as set forth in claim 2, 3, 5 or 6, comprising an eluent reserving container for reserving eluent to be fed by the liquid chromatograph pump, a low pressure pump being provided between the eluent reserving container and the first pump, and a change-over valve, a passage communicated to the eluent reserving container and a passage communicated to a column being provided on the downstream side of the second pump, wherein the low pressure pump is operated so as to feed liquid at a large flow rate in order to fill the eluent in the

passages on the downstream side while discharging air bubbles remaining in the pumps and the passages, thereafter, the change-over valve is connected to the passage communicated to the column, and then a trace of the eluent is fed by the first pump and the second pump.

8. A liquid chromatograph pump system comprising a liquid chromatograph pump, a container for reserving a solution, a low pressure pump provided between the liquid chromatograph pump and the container, a first passage for returning eluent discharged from the liquid chromatograph pump into the container, a second passage for feeding the eluent discharged from the liquid chromatograph pump to an injector, and a change-over valve for changing over communication between the first passage and the second passage.

9. A liquid chromatograph pump as set forth in claim 1 or 4, wherein a liquid flow rate range is from about 0.1 nL/min to 50  $\mu$ L/min.

10. A liquid chromatograph pump system as set forth in claim 8, wherein a liquid flow rate range is from about 0.1 nL/min to 50  $\mu$ L/min.